General

Guideline Title

ACR Appropriateness Criteria® blunt chest trauma — suspected aortic injury.

Bibliographic Source(s)

Kim H, Rybicki FJ, Majdalany BS, Francois CJ, Gerhard-Herman MD, Gornik HL, Moriarty JM, Norton PT, Ptak T, Weiss CR, Kalva SP, Expert Panel on Vascular Imaging. ACR Appropriateness CriteriaÂ® blunt chest trauma â€" suspected aortic injury [online publication]. Reston (VA): American College of Radiology (ACR); 2014. 7 p. [47 references]

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Demehri S, Rybicki FJ, Dill KE, Desjardins B, Fan CM, Flamm SD, Francois CJ, Gerhard-Herman MD, Kalva SP, Kim HS, Mansour MA, Mohler ER, Oliva IB, Schenker MP, Weiss C, Expert Panel on Vascular Imaging. ACR Appropriateness Criteria® blunt chest trauma - suspected aortic injury. [online publication]. Reston (VA): American College of Radiology (ACR); 2011. 5 p. [41 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

Regulatory Alert

FDA Warning/Regulatory Alert

Note from the National Guideline Clearinghouse: This guideline references a drug(s) for which important revised regulatory and/or warning information has been released.

- December 14, 2016 – General anesthetic and sedation drugs : The U.S. Food and Drug Administration (FDA) is warning that repeated or lengthy use of general anesthetic and sedation drugs during surgeries or procedures in children younger than 3 years or in pregnant women during their third trimester may affect the development of children's brains. Consistent with animal studies, recent human studies suggest that a single, relatively short exposure to general anesthetic and sedation drugs in infants or toddlers is unlikely to have negative effects on behavior or learning. However, further research is needed to fully characterize how early life anesthetic exposure affects children's brain development.

Recommendations

Major Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Blunt Chest Trauma—Suspected Aortic Injury

Radiologic Procedure	Rating	Comments	RRL*
CTA chest with contrast	9	This is the diagnostic test of choice for suspected blunt aortic injury.	☢☢☢
X-ray chest	9	Radiographs are complementary to more definitive studies.	☢
MRA chest without and with contrast	7	This procedure should be performed on patients with contraindication to CTA.	O
Aortography thoracic	6		☢☢☢
CT chest without contrast	5		☢☢☢
US echocardiography transesophageal	5		O
MRA chest without contrast	5		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Introduction/Background

Trauma ranks fifth behind cardiovascular diseases, cancer, chronic lower respiratory diseases, and cerebrovascular diseases as a cause of death in the United States. Seventy-five percent of the deaths from blunt trauma are due entirely or in part to chest injuries. Although reported incidence of aortic injury is approximately 5%, only 20% of patients with isolated aortic rupture will survive the initial injury. Of those who survive the initial injury, approximately 30% will die within first 6 hours and 49% within 24 hours. With advanced imaging technology leading to accurate diagnosis, coupled with innovative procedures such as endovascular graft repair, the mortality rate has decreased over time.

There are 4 theories of mechanism of aortic injury: 1) sudden increase in intravascular pressure, 2) shearing due to sudden deceleration, 3) sudden stretching of the isthmus, and 4) osseous pinch. One study physically demonstrated properties of stretching of the isthmus and suggested that a better understanding of mechanism of injury may result in improvement in vehicle safety. Whatever the mechanism may be, isolated thoracic aortic injury tends to occur most commonly distal to the left subclavian artery (79%). Of these, 61% arise at the aortic isthmus and 21% at the ascending aorta or the aortic arch. Preservation of the adventitia is crucial to maintain a barrier to exsanguination in survivors. Therefore, most demonstrate injury to the intima and media (60%) with intact adventitia. Although survival has been reported in the past, complete laceration of the aorta more commonly results in death at the accident site and is seen at autopsy. Such rare cases of survival are often due to contained pseudoaneurysm by periaortic tissue. Chronic pseudoaneurysm may arise years after the traumatic event.

To add to difficulties of correctly identifying patients with aortic injury, there is great variability in presentation. Patients may present in full cardiovascular collapse or complain of chest pain, midscapular pain, abdominal pain, dyspnea, tachycardia, hemoptysis, and cyanosis. Even with clinical manifestations, most of these findings are a result of other related chest injuries. In patients with aortic rupture, 36% had minimal or no evidence of external injury. Because of the variable presentation, a high index of suspicion for traumatic rupture of the aorta must be assumed for any patient who has sustained high-speed rapid deceleration.

Modern imaging technologies enable accurate diagnosis and treatment planning, including the identification of minimal aortic injury and small tears of the intima. The Vancouver simplified grading system demonstrated correlation with patient mortality: grade I (minimal aortic injury) and II (intimal flap larger than 1 cm) injuries demonstrated 100% survival, grade III (traumatic pseudoaneurysm) demonstrated 90% survival, and grade IV (active contrast extravasation) demonstrated 33% survival, allowing early prognostication of patients.

Overview of Imaging Modalities

Chest Radiography

Chest radiography (CXR) is the standard first examination for evaluation of blunt aortic injury (BAI) and is often included in most trauma center protocols in the initial evaluation of patients with polytrauma. Radiographs are complementary to more definitive studies such as computed tomography angiography (CTA) of the chest with contrast or magnetic resonance angiography (MRA) of the chest without and with contrast. Even though some studies suggest reserving further imaging with normal CXR for certain populations, if aortic injury is suspected, CXR should be followed with CTA, as approximately 7% of patients with BAI will have a normal CXR. Alternatively as noted below, MRA of the chest without and with contrast can be used to confirm clinically suspected traumatic injury to the aorta.

Uncertainty of patient stability and injury can limit image acquisition in the trauma setting, sometimes limiting a study to supine portable anteroposterior (AP) radiographs that magnify the width of the superior mediastinum. Sitting the patient upright when feasible for an anteroposterior radiograph will mitigate this technical limitation. A widened mediastinum suggests hematoma. However, hemorrhage in the mediastinum is most often commonly from rupture of small arteries and veins, and this finding is not specific for aortic injury. Although first and second rib fractures indicate a significant trauma, data suggest that these injuries are not associated with greater incidence of aortic injury. Other findings include obscuration of aortic knob, AP window, and superior mediastinum, left paraspinous line displacement, deviation of the trachea, and enlargement of the aortic knob. Although all radiography findings can suggest of aortic injury, the sensitivity is also <100%. In patients with an abnormal CXR, thoracic CT was more likely to alter management, and if aortic injury is suspected then concomitant CTA should be performed.

Computed Tomography Angiography

Advancement in technology and availability has increased the role of CT for assessment of patients with suspected aortic injury. Multidetector CT protocols and image postprocessing allow reconstruction of angiographic images of the aorta and its branches in multiple planes. Electrocardiography (ECG) gating allows even better visualization of the aortic root by decreasing pulsation artifact, allowing radiologists to more confidently exclude aortic root injuries from artifacts without proceeding with more invasive studies. Studies have shown high sensitivity and negative predictive value in the evaluation of suspected traumatic aortic injury when there are no signs of direct aortic injury such as an intimal flap, change in aortic contour or caliber, intraluminal irregularity, pseudoaneurysm, or intramural hematoma. Some authors have found that even in the presence of mediastinal hematoma, aortic injury is unlikely without direct evidence of aortic injury on CTA. Others have shown a high specificity for aortic injury when such direct signs are present. False-positive scans may occur secondary to false identification of ductus arteriosus remnant or atherosclerotic plaque as aortic injury. Many centers have abandoned aortography in the initial evaluation of patients at risk of aortic injury and instead use CTA. With improved sensitivity, specificity, and negative predictive value approaching 100%, along with the ability to detect other occult thoracic findings such as pneumothorax, pulmonary contusions, and fractures, CTA has gained wide approval and acceptance as the diagnostic test of choice for evaluation of BAI.

Computed Tomography

It has been suggested that routine CT has relatively lower, though still substantial, added diagnostic value compared with selective CT of the chest in patients with severe blunt trauma. In patients with absolute contraindication to intravenous iodinated contrast material, noncontrast CT of the chest may be a good alternative diagnostic test. Although intraluminal integrity of the aorta cannot be assessed, absence of mediastinal hematoma or the ability to exclude other causes of mediastinal widening such as mediastinal fat, anatomic variation, or artifact may be enough to exclude aortic injury in certain patients. Multiple studies have found, in absence of mediastinal hematoma, that the probability of significant aortic injury is very low. Studies have confirmed that patients with a negative chest CT in this setting have favorable clinical outcomes.

Magnetic Resonance Angiography

Due to long acquisition time, clinical instability of the patient, restricted accessibility to patient, and patient motion secondary to loss of consciousness or ventilator dependence, MR does not play a significant role in the initial diagnostic evaluation of the critically ill, hemodynamically unstable patients. Despite such limitations, MRA has proven to be useful in evaluation of chronic traumatic aortic pseudoaneurysms. The benefit of MRI/MRA is its ability to incorporate functional cardiac data much like transthoracic echocardiography (TTE)/transesophageal echocardiography (TEE) while providing excellent visualization of the vasculature. Typically, MRA of the chest without and with contrast is performed in lieu of CTA for those patients with relative contraindication. Breath-hold ECG-gated contrast-enhanced MRA can provide diagnostic images of the thoracic aorta in cooperative, hemodynamically stable patients with blunt chest trauma, especially in patients with contraindication to iodinated contrast material.

Aortogram

Before technical advances in CT, thoracic aortography was widely accepted as the reference standard for evaluating patients with suspected aortic injury. The aortogram establishes the diagnosis, defines the anatomy of the lesion, and also identifies additional sites of injuries. Approximately 20% of patients have multiple tears. The catheter-based aortogram has become a problem-solving tool in certain patients with indirect signs of aortic injury on CT. Various film sequences have been used, including AP, lateral, and oblique projections. It should be emphasized that more than one projection should be used to detect an aortic injury, as aortic injuries may be missed on single-projection views. Because acutely injured patients

are in a hyperdynamic state, high-contrast volumes of 60 to 70 mL must be rapidly injected. The development of intravascular ultrasound (IVUS) has offered an adjunct to standard transfemoral aortography. Although the routine use of IVUS is neither indicated nor practical, in a few cases it has been found to be useful in confirming or excluding thoracic aortic injury when angiographic findings are subtle or uncertain. For example, one study demonstrated a sensitivity of the initial aortogram for minimal aortic injury to be 37.5%; however, with IVUS, sensitivity, specificity, and negative predictive value were 100%, suggesting its utility in identifying subtle intramural abnormalities.

Transesophageal Echocardiography

Echocardiography has been used in the acute trauma setting to evaluate the heart for contusions and abnormalities in the thoracic aorta. Focused Cardiac Ultrasound (FoCUS) in the emergent setting is typically performed by emergency medicine physicians and has been recommended for clinically suspected cardiac injury, particularly with respect to volume resuscitation. However, FoCUS has not been recommended for suspected injury to the aorta. TTE is also of limited use and, like FoCUS, will not be further evaluated. TEE has a higher sensitivity than TTE. Given that only 4% of patients with combined aortic rupture and cardiac injury survive the initial injury when compared to 20% of those with isolated aortic rupture, additional information obtained by TEE maybe helpful for prognosis. TEE is operator-dependent, requires sedation, and is more invasive than CT. In some patients, blind spots created by the tracheobronchial bifurcation may preclude adequate visualization of portions of the aortic arch. Other blind spots for TEE are the distal ascending aorta and the aortic arch vessels, sites of traumatic injury in up to 20% of patients with blunt chest trauma. Thus, TEE is not recommended as a sole diagnostic study for patients with suspected aortic injury. When CTA must be delayed for emergent abdominal exploration, intraoperative TEE may be a useful modality to evaluate for aortic injury. Several studies have reported excellent diagnostic accuracy using TEE for recognizing aortic injury. This experience, however, has not been uniformly positive.

Summary of Recommendations

- The literature supports chest radiograph as the initial screening examination in the patient who has sustained blunt chest trauma.
- CTA is the most sensitive and specific examination for acute aortic injury and has replaced thoracic aortography as the primary aortic imaging tool in many trauma centers.
- MRA is usually appropriate and is typically performed for patients with contraindication to CTA.
- With this expanding role for CTA, the use of IVUS and TEE is diminishing, but they may be useful in select cases.

Abbreviations

- CT, computed tomography
- CTA, computed tomographic angiography
- MRA, magnetic resonance angiography
- US, ultrasound

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."		

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Blunt chest trauma, suspected aortic injury

Guideline Category

Diagnosis

Evaluation

Clinical Specialty

Cardiology

Critical Care

Emergency Medicine

Internal Medicine

Radiology

Surgery

Thoracic Surgery

Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of various imaging modalities for the evaluation of patients with blunt chest trauma and suspected aortic injury

Target Population

Patients with blunt chest trauma and suspected aortic injury

Interventions and Practices Considered

1. X-ray, chest
2. Computed tomographic angiography (CTA), chest, with contrast
3. Magnetic resonance angiography (MRA), chest
    - Without and with contrast

    - Without contrast
4. Computed tomography (CT), chest, without contrast
5. Ultrasound (US), transesophageal echocardiography
6. Aortography, thoracic

Major Outcomes Considered

- Utility of radiologic examinations in differential diagnosis
- Sensitivity, specificity, and negative predictive value of radiologic examinations

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search Summary

Of the 41 citations in the original bibliography, 31 were retained in the final document. Articles were removed from the original bibliography if they were more than 10 years old and did not contribute to the evidence or they were no longer cited in the revised narrative text.

A new literature search was conducted in April 2014 to identify additional evidence published since the *ACR Appropriateness Criteria® Blunt Chest Trauma — Suspected Aortic Injury* topic was finalized. Using the search strategy described in the literature search companion (see the "Availability of Companion Documents" field), 70 articles were found. Seven articles were added to the bibliography. Sixty-three articles were not used due to either poor study design, the articles were not relevant or generalizable to the topic, the results were unclear, misinterpreted, or biased, or the articles were already cited in the original bibliography.

The author added 9 citations from bibliographies, Web sites, or books that were not found in the new literature search.

See also the American College of Radiology (ACR) Appropriateness Criteria® literature search process document (see the "Availability of Companion Documents" field) for further information.

Number of Source Documents

Of the 41 citations in the original bibliography, 31 were retained in the final document. The new literature search conducted in April 2014 identified seven articles that were added to the bibliography. The author added 9 citations from bibliographies, Web sites, or books that were not found in the new literature search.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Study Quality Category Definitions

Category 1 - The study is well-designed and accounts for common biases.

Category 2 - The study is moderately well-designed and accounts for most common biases.

Category 3 - There are important study design limitations.

Category 4 - The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:

a. The study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description).
b. The study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence.
c. The study is an expert opinion or consensus document.

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author assesses the literature then drafts or revises the narrative summarizing the evidence found in the literature. American College of Radiology (ACR) staff drafts an evidence table based on the analysis of the selected literature. These tables rate the study quality for each article included in the narrative.

The expert panel reviews the narrative, evidence table and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the variant table(s). Each individual panel member assigns a rating based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development documents (see the "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

Description of Methods Used to Formulate the Recommendations

Rating Appropriateness

The American College of Radiology (ACR) Appropriateness Criteria (AC) methodology is based on the RAND Appropriateness Method. The appropriateness ratings for each of the procedures or treatments included in the AC topics are determined using a modified Delphi method. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. The expert panel members review the evidence presented and assess the risks or harms of doing the procedure balanced with the benefits of performing the procedure. The direct or indirect costs of a procedure are not considered as a risk or harm when determining appropriateness. When the evidence for a specific topic and variant is uncertain or incomplete, expert opinion may supplement the available evidence or may be the sole source for assessing the appropriateness.

The appropriateness is represented on an ordinal scale that uses integers from 1 to 9 grouped into three categories: 1, 2, or 3 are in the category "usually not appropriate" where the harms of doing the procedure outweigh the benefits; and 7, 8, or 9 are in the category "usually appropriate" where the benefits of doing a procedure outweigh the harms or risks. The middle category, designated "may be appropriate", is represented by 4, 5, or 6 on the scale. The middle category is when the risks and benefits are equivocal or unclear, the dispersion of the individual ratings from the group median rating is too large (i.e., disagreement), the evidence is contradictory or unclear, or there are special circumstances or subpopulations which could influence the risks or benefits that are embedded in the variant.

The ratings assigned by each panel member are presented in a table displaying the frequency distribution of the ratings without identifying which members provided any particular rating. To determine the panel's recommendation, the rating category that contains the median group rating without disagreement is selected. This may be determined after either the first or second rating round. If there is disagreement after the second rating round, the recommendation is "May be appropriate."

This modified Delphi method enables each panelist to articulate his or her individual interpretations of the evidence or expert opinion without excessive influence from fellow panelists in a simple, standardized and economical process. For additional information on the ratings process see the Rating Round Information document on the ACR Web site.

Additional methodology documents, including a more detailed explanation of the complete topic development process and all ACR AC topics can be found on the ACR Web site (see also the "Availability of Companion Documents" field).

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

Summary of Evidence

Of the 47 references cited in the *ACR Appropriateness Criteria® Blunt Chest Trauma-Suspected Aortic Injury* document, all of them are categorized as diagnostic references including 1 well-designed study, 7 good quality studies, and 12 quality studies that may have design limitations. There are 27 references that may not be useful as primary evidence.

While there are references that report on studies with design limitations, 8 well-designed or good quality studies provide good evidence.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Selection of appropriate radiologic imaging procedures for evaluation of patients with blunt chest trauma, suspected aortic injury

Potential Harms

Relative Radiation Level

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

Qualifying Statements

Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Kim H, Rybicki FJ, Majdalany BS, Francois CJ, Gerhard-Herman MD, Gornik HL, Moriarty JM, Norton PT, Ptak T, Weiss CR, Kalva SP, Expert Panel on Vascular Imaging. ACR Appropriateness CriteriaÂ® blunt chest trauma â€" suspected aortic injury [online publication]. Reston (VA): American College of Radiology (ACR); 2014. 7 p. [47 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

1995 (revised 2014)

Guideline Developer(s)

American College of Radiology - Medical Specialty Society

Source(s) of Funding

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Vascular Imaging

Composition of Group That Authored the Guideline

Panel Members: Hansol Kim, MD (*Research Author*); Frank J. Rybicki, MD, PhD (*Principal Author, Specialty Chair*); Bill S. Majdalany, MD (*Panel Vice-chair*); Christopher J. Francois, MD; Marie D. Gerhard-Herman, MD; Heather L. Gornik, MD; John M. Moriarty, MB, BCh; Patrick T. Norton, MD; Thomas Ptak, MD, PhD; Clifford R. Weiss, MD; Sanjeeva P. Kalva, MD (*Panel Chair*)

Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Demehri S, Rybicki FJ, Dill KE, Desjardins B, Fan CM, Flamm SD, Francois CJ, Gerhard-Herman MD, Kalva SP, Kim HS, Mansour MA, Mohler ER, Oliva IB, Schenker MP, Weiss C, Expert Panel on Vascular Imaging. ACR Appropriateness Criteria® blunt chest trauma - suspected aortic injury. [online publication]. Reston (VA): American College of Radiology (ACR); 2011. 5 p. [41 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Electronic copies: Available from the American College of Radiology (ACR) Web site .

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2015 Feb. 3 p. Electronic copies: Available from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 2015 Feb. 1 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2015 Feb. 3 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria®. Procedure information. Reston (VA): American College of Radiology; 2015 Feb. 2 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria® blunt chest trauma — suspected aortic injury. Evidence table. Reston (VA): American College of Radiology; 2014. 16 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria® blunt chest trauma — suspected aortic injury. Literature search. Reston (VA): American College of Radiology; 2014. 1 p. Electronic copies: Available from the ACR Web site.

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI on February 20, 2001. The information was verified by the guideline developer on March 14, 2001. This summary was updated by ECRI on March 6, 2006. This summary was updated by ECRI Institute on June 8, 2010. This summary was updated by ECRI Institute on January 13, 2011 following the U.S. Food and Drug Administration (FDA) advisory on gadolinium-based contrast agents. This summary was updated by ECRI Institute on March 9, 2012. This summary was updated by ECRI Institute on July 29, 2015. This summary was updated by ECRI Institute on February 15, 2017 following the U.S. Food and Drug Administration advisory on general anesthetic and sedation drugs.

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